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Contents

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RELATION OF POTATO VARIETIES TO INCIDENCE OF PHYSIOLOGICAL INTERNAL TUBER NECROSIS

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(Accepted for publication, Nov. 22, 1949

Field studies of varietal differences in incidence of non-parasitic internal tuber necrosis in the late potato crop, conducted at the Hancock Station, Waushara County, Wisconsin on Plainfield sand during 1938 to 1943, inclusive have been reported (3, 4, 5). The present paper is a report of additional field investigations also carried out at Hancock which have been underway since 1944. Older standard varieties were included in the field tests, in addition to the more recently introduced varieties, because of their known reaction to internal necrosis and adaptability to Central Wisconsin growing conditions. The incidence of internal necrosis (5, 8) was determined directly after harvest in four replicates of each variety.

Over a period of years considerable variation in relative susceptibility of potato varieties to internal necrosis has been observed. However, a comparative index (5-year average) for the varieties under test and a tentative classification of varieties are given in table 1.

TABLE 1.—*Reaction of American potato varieties to internal necrosis.*

Variety	Internal Necrosis Index					Mean Necrotic Index
	1945	1946	1947	1948	1949	
Waseca	—	—	—	—	0	0[1]
Setapa	—	—	—	—	0	0[1]
Placid	0	0	0	0	0	0
Desota	0	0	0	0	0	0
Marygold	0	0	0	0	0	0
Triumph[2]	0	0	0	0	0	0
Kasota	6	0	1	0	7	2.8
LaSalle	2	4	3	3	0	2.4
Hebron	3	4	3	6	4	4.0
Virgil	8	5	4	3	1	4.2
Red Warba	16	0	4	0	2	4.4
Kennebec	—	—	—	—	5	5.0[1]
Empire	6	7	9	6	3	6.2
Teton	7	6	9	5	16	8.6
Mohawk	12	14	11	5	6	9.6
Pontiac	17	11	12	10	5	11.0
Menominee	33	8	8	5	10	12.8
Earliest of All	21	13	17	12	7	14.0
Erie	45	17	3	4	4	14.6
Gold Coin	17	27	21	7	5	15.4
Pennigan	42	11	11	10	9	16.6
McClure	44	21	8	3	9	17.0
Essex	16	21	19	24	6	17.2
Ontario	19	25	19	14	27	20.8
Hindenburg	31	26	19	23	16	23.0
Patomac	43	15	30	24	10	24.4
Pawnee	63	39	16	15	24	31.4
Russet Rural[1 2]	56	31	28	23	21	31.8
Katahdin[2]	57	23	44	21	19	32.8

[1] — One year test

[2] — 6 year mean necrotic index—1938 to 1943 inclusive

Triumph 0

Russet Rural 40.5

Katahdin 39.5

Differences in the incidence of internal necrosis are apparent when the indices are compared. Triumph, Waseca, Setapa, Placid, Desota and Marygold have been entirely free of internal necrosis. Kasota, LaSalle, Hebron, Virgil, Red Warba, Kennebec, Empire, Teton and Pontiac were affected very much less than Menominee, Earliest of All, Erie and Gold Coin. An intermediate degree of internal necrosis was shown by Pennigan, McClure, and Essex. The most susceptible varieties under test were, in order of increasing susceptibility, Ontario, Hin-

TABLE 2.—*Occurrence of internal tuber necrosis in the Ontario variety in Wisconsin*—1949

Location and Lot		Soil Type	Per cent Clean and Slight	Per cent Moderate and Severe	Tubers Examined				Internal Necrosis Index
					Clean	Slight	Moderate	Severe	
Three Lakes	—#1	Sandy loam	76.2	23.8	92	49	26	18	28
(Northern Wisconsin)	—#2	"	75.5	24.5	82	35	24	14	27
	—#3	"	79.3	20.7	79	32	16	13	25
	—#4	"	67.9	32.1	81	27	22	29	33
	—#5	"	65.0	35.0	71	15	18	19	29
	—#6	"	72.8	27.2	97	29	21	26	29
		Average	72.8	27.2					28.5
Antigo	—#1	Silt loam	76.3	23.7		58	26	8	31
(North Central Wis.)	—#2	"	75.8	24.2	51	61	24	14	32
		Average	76.05	23.95	58				31.5
Plainfield	—#1	Muck	84.0	16.0		27	9	7	22
(Central Wisconsin)	—#2	"	82.7	17.3	57	20	10	8	21
		Average	83.4	16.6	66				21.5
Racine	—#1	Silt loam	72.4	27.6		34	26	21	29
(South Eastern Wis.)	—#2	Silt loam	73.4	26.6	82	29	21	17	30
		Average	72.9	27.1	76				29.5

denburg, Patomac, Pawnee, Russet Rural and Katahdin. Two varieties, Ontario and Pawnee were outstanding in their susceptibility, exhibiting in many cases, a very severe irregular blotch type of internal necrotic discoloration in addition to diffused necrosis.

During the 1949 season, plantings of Ontario over the entire state in all types of soils, showed a very high incidence of internal necrosis of the severe type. The locations, soil types, internal necrosis index, as well as percentage of tubers showing little or no necrosis and those exhibiting moderate and severe internal discoloration in the Ontario lots examined are given in table 2.

The occurrence of internal necrotic discoloration in Ontario produced on muck soils in 1949 is the first record of physiological tuber necrosis on this type of soil in Wisconsin. Other potato varieties (Pontiac, Katahdin, Chippewa and Cobbler) grown adjacent to Ontario on the mucks when examined showed no tubers affected. The Ontario is the only variety which exhibited extreme susceptibility to internal necrosis over a wide range of growing conditions and on various soil types during the 1949 growing season.

The severe losses sustained during certain seasons in the late crop in Central Wisconsin caused by internal tuber necrssrs and in the Ontario variety throughout the entire state this past season, emphasizes the importance of continued field trials in search of adaptable, necrosis-resistant varieties and indicates the great need of potato improvement in this direction.

In addition to the Americon potato varieties under test during 1944 through 1949, 13 British varieties were also tested. Differences in varietal susceptibility to internal tuber necrosis in the British varieties were as great as those found in American varieties. Differences in the incidence of internal tuber necrosis in British varieties as expressed by the necrotc index are shown in table 3. King Edward and Up to Date, have consistently shown a low necrotic index, while Arran Scott, Great Scot Epicure, Arran Consul and Majestic have been the most susceptible over a period of years under Central Wisconsin conditions. Differences in the incidence of internal rust spot in British varieties have been reported from England (1, 2, 6) and Holland (7).

Literatuge Cited

1. Burr, S., and Millard, W. A. 1938. Sprain or internal rust spot of potatoes. Ann. Appl. Biol. 15: 563-585.
2. ———, and Millard, W. A. 1938. Two potato diseases. Variety trials for resistance to sprain and internal rust spot (canker type) in potatoes. Scottish Farmer 46: 1678.

TABLE 1.—*Insect and early blight control on potato spray plots, Lake City Experiment Station, 1948.*

Material and Dosage	Insect Control Percentage					Early Blight Per Cent Defoliation	Yield U. S. No. 1 Bus. Per Acre
	Potato Leaf Hopper	Six-Spotted Leaf Hopper	Spittle Bug	Aphids	Potato Flea Beetle		
1. (1) 629 + DDT (3 - 1½ - 100)	87	61	41	49	99	75	356.5
2. Yel. - cuprocide + Parathion (1½ - 1 - 100)	69	64	11	100	99	57	249.7
3. (2) 629 + 308 + DDT (3 - 3 - 1½ - 100)	72	67	31	42	99	75	305.4
4. Yel. Cuprocide + Parathion (1½ - 1 - 100)	25	70	0	100	99	50	253.3
5. Zerlate + CM150 (DDT) (2 - 2 - 100)	89	61	43	25	99	58	382.1
6. TBC + CM152 (DDT) (4 - 2 - 100)	77	70	70	64	100	65	282.8
7. Cu-Zn chromate + DDT (2 - 1½ - 100)	64	85	15	48	100	41	280.6
8. (3) Cu. 8 Quinol. + DDT (1 - 1½ - 100)	55	58	22	54	100	65	285.9
9. Dithane D-14 + Shell 25 em. (2 qts. - 1Zn ½ Lime - 1 qt. - 100)	64	54	32	74	100	55	281.3
10. Dithane D-14 + Shell DDT (same as above + 2 lbs. DDT - 100)	68	42	33	57	99	50	342.9
11. Zerlate + D25 (25 per cent DDT) (2 - 1 qt. - 100)	66	70	18	62	100	48	314.6
12. Zerlate + 50 W DDT (2 - 2 - 100)	79	82	56	57	99	58	323.4
13. DDT alone (1½ - 100)	66	64	46	64	99	83	304.9
14. COCS + Dethyl (25 per cent em.) (3½ - 1 qt. - 100)	68	61	35	53	98	83	278.0

THE RINGSPOT TYPE OF POTATO VIRUS X[1]

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(Accepted for publication Oct. 5, 1949)

A severe disease of potato (*Solanum tuberosum*, L.) due to infection with the ringspot type of virus X has been observed for the past several years in the Wisconsin seed fields of Chippewa, Sebago, Red Warba, Pontiac and Katahdin (3, 4, 5). Infected plants are characterized by a foliar mottle and necrosis or even lethal top necrosis. Isolations from such plants to *Nicotiana rustica* L. and *N. tabacum* L. var. Havana 38 at 24°C. resulted in only severe ringspot symptoms. A clear concentrically-lined ring was always the dominant lesion type. However, two others were also isolated from some of these plants, one a ring type with a necrotic border and the other a necrotic-spot or local-lesion type. By means of single-lesion isolations, apparently pure cultures of the above three types were obtained. All three caused characteristic symptoms on *N. rustica, N. tabacum and N. glutinosa* L. at 24°C., but only necrotic-spot-type local lesions on the inoculated leaves of these hosts at 16°C. The three types produced spot-necrosis of tobacco when combined with the common strain of potato virus Y and streak of tomato (*Lycopersicum esculentum* Mill.) when mixed with tobacco virus I.

Older American potato varieties, such as Triumph, Cobbler, Green Mountain, Russet Burbank and Russet Rural are universally infected with a latent mild mottle type of virus X. The ringspot strain of virus X was found to accompany the mottle in all symptomless plants of the above varieties tested, though there was considerable variation in relative amount of ringspot present and also in the intensity of mottle in different varieties and, to a lesser extent, between plants within a variety. Apparently pure cultures of ringspot were separated from the attendant mottle in apparently healthy potatoes by single-lesion isolations from inoculated tobacco. The necrotic-ring and necrotic-spot types were also isolated from symptomless plants of the above varieties.

Ringspot isolates derived from severely diseased field potatoes, from apparently healthy greenhouse-grown potatoes and four ringspot cultures from other laboratories were used as inoculum in a series of

[1]Published with the approval of the director, Wisconsin Agricultural Experiment Station. This work was supported in part by a grant from Lelah Starks.

potato inoculations. The latter cultures were the "virulent latent virus" from Early Rose (2), "severe X" from British Queen (1), a severe strain isolated from Arran Peak (6) and a ringspot type isolated from naturally infected pepper (*Capsicum annuum* L.) plants supplied by H. H. McKinney, U.S.D.A., Beltsville, Maryland. All isolates caused local lesions followed by severe systemic symptoms when inoculated to X-free plants of certain recently introduced potato varieties at 16°C. The response of Red Warba and Pontiac was very necrotic and inoculated plants were usually killed, whereas Ontario showed mainly mottle and crinkle with moderate necrotic flecking of the foliage. The isolates originally obtained from symptomless plants of older varieties were fully as virulent on X-free potatoes as those derived from potatoes showing severe symptoms. The original sap mixture of mottle and ringspot found in symptomles potatoes (Irish Cobbler, Triumph and Russet Rural) caused definite but less severe symptoms than pure ringspot on inoculation to X-free potatoes and the complex was recovered unchanged from the first as well as second generation plants.

Tolerance to ageing, dilution and heat was similar for the various ringspot isolates studied. A mottle type of virus X from Russet Rural completely protected *Datura stramonium* L. var. *tatula* against infection with any of the isolates tested. However, the isolate originally derived from pepper lacked an antigenic fraction possessed by 10 isolated from potato. A clear-ring type isolate from Red Warba infected all members of the Solanaceae tested, 4 members of the Labiatae, 10 species of Scrophulariaceae and 4 species of Amaranthaceae as shown in table 1.

TABLE 1.—*Symptoms produced on young non-solanaceous plants when mechanically inoculated with a clear-ring type isolate of potato virus X at a constant temperature of* 24°C.

Host	Symptoms Resulting from Inoculation
LABIATE (Mint)	
Salvia lancaefolia, Poir. (flowering sage)	Local: Numerous dark flecks, changing to local necrotic lesions in 5 days; premature leaf cast. Systemic: Slight chlorotic mottle and irregular necrotic lesions.
Nepeta cataria, L. (catnip)	Local: Few, chlorotic lesions; no necrosis. Not systemic.
Ocimum basillicum, L. (sweet basil)	Local: Clear ring lesions; no necrosis. Systemic: Few, clear ring lesions and mild chlorotic mottle; no necrosis.
Satureja hortensis, L. (summer savory)	Local: Necrotic flecks enlarging to form necrotic lesions; premature leaf cast. Systemic: Slight chlorotic mottle and moderate necrosis; some necrotic stem streaking; slight stunting.

SCROPHULARIACEAE (Figwort)

Veronica orchidea, Crantz.	Local: Irregular, scattered chlorotic lesions in 10 to 12 days; no necrosis. Not systemic.
V. serpyllifolia, L. (thyme leaved)	Local and systemic: as above.
V. teucrium, L. (saw-leaved)	Local and systemic: as above.
V. longifolia, L.	Local and systemic: as above.
Linaria cymbalaria, (L.) Mill (Kenilworth Ivy)	Local: Faint yellow halo-type lesions; no necrosis. Systemic: Mild interveinal chlorosis; no necrosis.
L. bipartita, Willd.	Local and systemic: no sysmptoms, carried.
L. maroccana, Hook.	Local and systemic: no symptoms, carried.
L. vulgaris, Hill. (toad flax)	Local and systemic: no symptoms, carried.
Digitalis lanata, Ehrh. (grecian foxglove)	Local: Necrotic flecks enlarging to reddish-brown irregular areas and ring lesions; more severe at 16°C. Not systemic.
D. ambigua, Murr. (yellow foxglove)	Local: Few, faint halo-type lesions developing necrotic borders; more severe at 16°C. Not systemic.

AMARANTHACEAE (Amaranth)

Amaranthus caudatus L. (tassel flower)	Local: Conspicuous small brick-red lesions in 3 to 4 days, on enlarging, outer edge becomes dark; premature leaf abscission. Not systemic.
A. hybridus L. (green amaranth)	Local: Conspicuous small necrotic lesions in 3 days, enlarging to involve the entire leaf; premature leaf abscission. Not systemic.
A. retroflexus L. (redroot pigweed)	Local and systemic: as above.
A. tricolor L. var. aurora	Local: Conspicuous small brick-red lesions in 3 days, becoming pigmented, followed by diffuse chlorotic mottle and general necrosis, premature leaf abscission. Not systemic.

A clear-ring type isolate was transmitted by dodder (*Cuscuta campestris* Yunker) but not by the potato flea beetle (*Epitrix cucumeris* Harris).

Field inoculations were made to 41 potato varieties and severe symptoms developed in inoculated plants of some of the more recently introduced varieties. Symptoms of field inoculated plants in the second generation were also severe, but in the third year of infection, symptoms were definitely less marked and the virus was attenuated.

Field and greenhouse inoculations showed that all plants of older American potato varieties tested were carrying a latent mild type of virus X and hence did not develop symptoms on inoculation. There was no evidence of entry of the ringspot virus. Greenhouse inoculations were made to Ontario, Chippewa, Sebago, Pontiac and Katahdin and tests for the presence of virus X were made of plants from the same tubers from which inoculated plants were grown. The plants which showed no symptoms on inoculation were found to be previously infected with a mild type of virus X as evidenced by serological precipitin tests and cross-protection reactions on *D. stramonium*. The plants which developed necrotic local lesions and severe systemic symptoms on inoculation were originally free from virus X. Pontiac and Katahdin showed, in addition to chlorotic mottle and crinkle, severe systemic necrosis and the plants were usually killed. Ontario, Chippewa and Sebago, on the other hand, showed systemic mottle with much less necrosis. Some plants of Chippewa and Sebago gave a partial response to inoculation. though previous infection with virus X was demonstrated by precipitin and cross-protection tests. It was shown that this incomplete protection was due to a delayed movement of the latent virus from the tuber into the aerial parts of the plant in sufficient concentration to prevent entry of the ringspot virus. Delayed movement of the virus in plants of this type tends to make tests for the presence of virus X unreliable when based on sprouts or even young plants.

Literature Cited

1. Clinch, Phyllis, E. M. 1944. Observations on a severe strain of potato virus *X*. Proc. R. Dublin Soc. N. S. 23: 273-299, illus.
2. Jones, L. K., Anderson, E. J., and Burnett, G. 1934. The latent virus of potatoes. Phytopath. Zietschr. 7: 93-115, illus.
3. Ladeburg, R. C. and Larson, R. H. 1949. Reaction of potato varieties to the virulent ringspot virus. Phytopath. 39: 12.
4. Larson, R. H. 1943. A foliar mottle and necrosis in Chippewa potatoes associated with infection by a strain of the potato virus X. Phytopath. 33: 1216-1217.
5. ———, and Ladeburg, R. C. 1949. Isolation of virulent ring-spot virus from "healthy" potatoes. Phytopath 39: 12.
6. Smith, K. M. 1946. Tomato black ring: a new virus disease. Parasitology 37: 126-130.

COSTS, YIELDS, AND PROFIT MARGINS IN POTATO PRODUCTION

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A phase of potato production which is often neglected in the more technical journals dealing with the subject is that having to do with production costs and the yield-profit relationship. An intimate knowledge of this subject, of course, comes only with the experience of raising and harvesting the crop for the commercial market, and most growers who are in the business in a commercial way perhaps assume that all are familiar with it as a matter of course. Calculation of the selling price necessary to break even is a basic consideration in the raising of vegetable crops, and will be of increasing importance to the potato grower in the years which lie ahead.

It is not difficult for the grower to calculate within fairly close limits the cost of producing a given quantity of potatoes at any yield level, taking into consideration the factors involved in his particular operation. It is important to bear in mind, in this connection that there are certain pre-harvest costs (seed, fertilizer, etc.) which can be calculated on a per acre basis and which do not vary with the yield obtained. There are other costs, mainly concerned in the harvesting of the crop, which are progressive in nature and must be calculated on a per bushel or per hundred-weight basis. It is the combination of these two costs at any given yield level which makes up the total cost of production.

To illustrate how these two costs may be plotted graphically to arrive at the overall cost of production, we have chosen the 1948 figures from the operation of our own farm on which we raised approximately 100 acres of potatoes. In our opinion, it is doubtful if the individual cost figures will change significantly in the immediate future. The overall costs may vary considerably, however, between different growers, depending on the methods of production and marketing that are used in each individual case. The point is that any grower can calculate his cost of production by plotting the combination of his pre-harvest and harvest costs at various yield levels. It is then possible, after determining the yield per acre, to determine the break-even point, or the selling price necessary to just cover the cost of raising the crop. In the same

manner, if the selling price is known, it is posible to calculate the yield necessary to reach the break-even point.

These facts are illustrated in the following diagrams, in which the following costs have been used as a basis for calculation:

Pre-Harvest Costs/Acre	
Seed	$50.00
Fertilizer	45.00
Plowing	2.50
Planting	2.75
Seed Cutting	1.50
Spraying	27.00
Cultivation	4.50
Irrigation	6.00
Cover Crop	10.25
Digging	3.50
Depreciation	30.00
Taxes	10.00
Insurance	2.20
Maintenance	10.00
Compensation	1.25
Electric and Telephone	1.00
Total	$207.45

Harvest Costs/Bu. Unit	
Picking	$0.07
Grading	.05
Hauling (field)	.015
Sacks	.12
Delivery	.18
Commission	.03
Total	$0.465

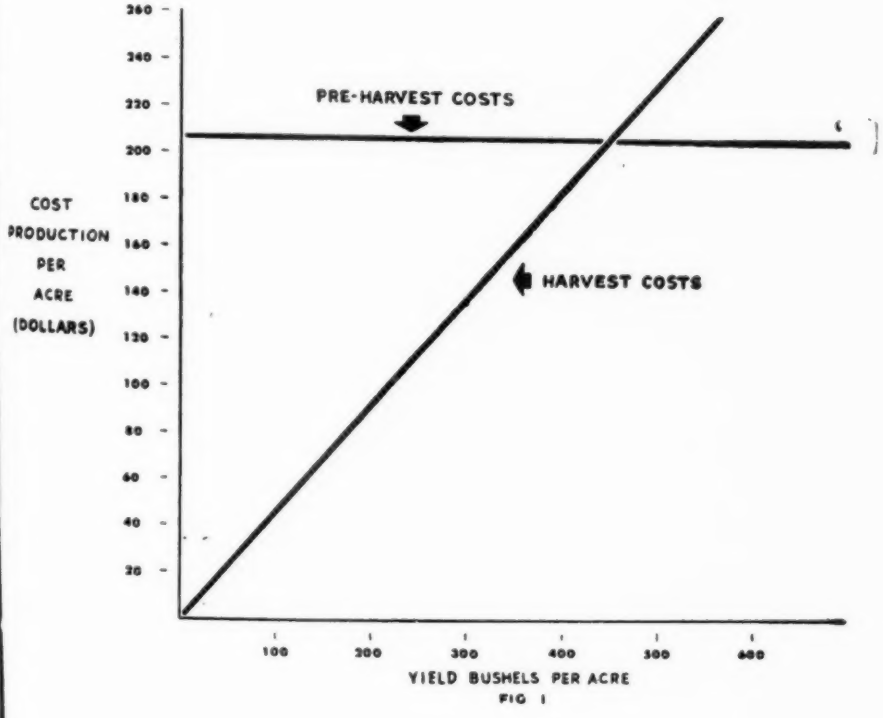

FIG 1

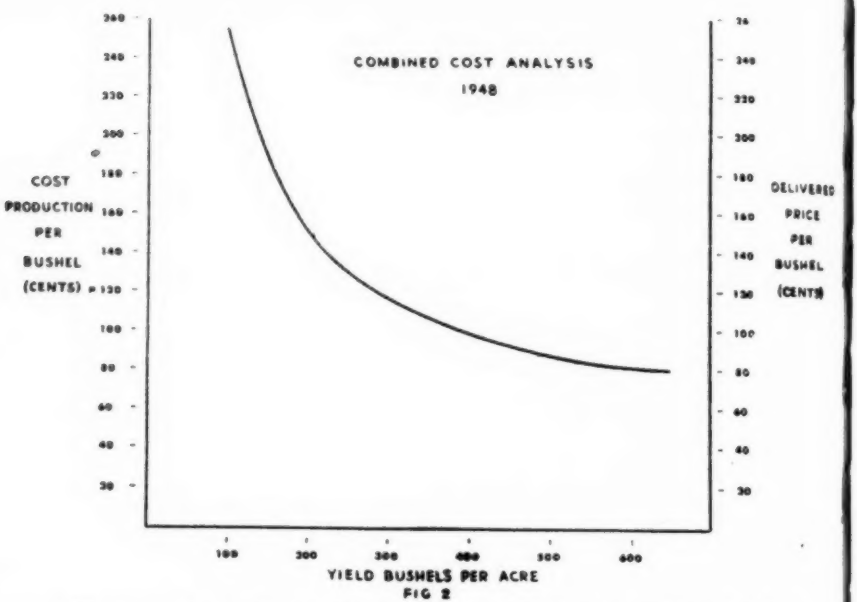

Figure 1. shows the pre-harvest costs plotted at a constant level when calculated on a per acre basis and harvest costs increasing with the yield in a regular manner. In figure 2. these two costs are combined on a cost per bushel basis and plotted against yield per acre. For example, at the 200 bushel per acre level, the pre-harvest costs would be $207.45/200 or $1.04 per bushel. The harvest costs would be constant for each bushel of potatoes produced and amount to $0.465 per bushel. The sum of these two costs is $1.50 per bushel, which represents the total cost of production at the 200 bushel per acre level. The same type of calculation is carried out at a series of yield levels to obtain the curve in figure 2. Once this curve is established for any individual operation it provides a convenient means of calculating profit margins at varying yield levels.

It is of interest to point out that the curve in figure 2. gradually approaches a straight line as the yield increases and the cost of production per bushel decreases. The reason for this, of course, is that while the harvest costs remain constant on a per bushel basis with increasing yields, the pre-harvest costs diminish regularly as they are divided over an increasing number of bushels. It is incorrect to assume that it requires a certain yield to meet expenses and that everything over that is profit. As these figures show, the margin of profit does increase as pre-harvest cost per bushel decreases with increasing yield, but this profit increase is not indefinite.

POTATO STORAGE AND QUALITY OF FRENCH FRIES
I. KATAHDIN*

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Potatoes selected for study as a part of an investigation of the effects of cooking on the vitamin and mineral content of 23 foods (3) were found to contain excessive amounts of reducing sugars when obtained on the Washington, D. C. market during January, 1946. These potatoes apparently had been exposed to low temperatures (2, 5, 7, 8). French fries made from them were generally poor in edible quality, confirming the Bureau's previous findings (8).

In order to improve the quality of french fries if possible, it was deemed advisable to lower the content of reducing sugars by conditioning the potatoes (2, 7, 8). A survey of available information revealed that there were no recorded observations concerning (a) the period of conditioning required at room temperature, 70 to 75°F. (21 to 24°C.), for desugaring to an acceptable level, potatoes which had been stored below 40°F. (4°C.); (b) the edible quality of french fries made from potatoes which had been appreciably desugared; (c) the influence of degree of mealiness of potatoes on rate of desugaring, and on edible quality of french fries prepared at intervals during conditioning periods. Therefore, to help provide the information needed, studies were conducted with "oversweet" potatoes of different varieties and mealiness, conditioned for varying periods before french frying. In this paper, the first of a series of three, results on Katahdin potatoes are reported.

EXPERIMENTAL PROCEDURE

Katahdin potatoes were furnished by the Bureau of Plant Industry, Soils, and Agricultural Engineering from surplus stock. They were harvested at Presque Isle, Maine, in late September, 1945. After a few days the potatoes were shipped to the Plant Industry Station, Belts-

*This research was done as part of a project supported in part by an allotment made by the Secretary of Agriculture from Special Research Funds (Bankhead-Jones Act of June 29, 1935).

ville, Maryland, where they were placed in a potato house on the 5th of October and held in typical winter farm storage, at 35 to 40°F. (1.5 to 4°C.).

On February 6, 1946, after 124 days in the potato house, a portion of potatoes was transferred to our laboratories. The potatoes were washed, wiped dry with towels, and sorted out into lots according to degree of mealiness by Smith's salt-density method (6). To carry out this procedure two salt solutions were prepared, the one of specific gravity 1.078 (22 ounces common salt in 11½ pints water), the other of specific gravity 1.088 (24⅔ ounces salt in 11 pints water), and the potatoes were placed in these solutions to determine their degree of mealiness: Potatoes that floated in the solution of specific gravity 1.078 were separated as non-mealy, those that sank in this solution but floated in the solution of specific gravity 1.088, slightly-to-medium mealy, and those than sank in the latter solution, mealy.

After the potatoes were identified as to their degree of mealiness, they were conditioned at 70 to 75°F. (21 to 24°C.) in a dark room, equipped with fans to circulate the air, for the following lengths of time: 7, 19, 28, 51, 72, 84, or 91 days. A second portion of the potatoes, held in the potato house for 158 days, was separated into lots according to degree of mealiness by the above method, and conditioned for 1 day. After 164 days in the potato house, a third portion of the potatoes, separated into lots according to degree of mealiness by the above method, was conditioned for 35, 43, 56, and 63 days.

At the end of each period of conditioning, potatoes of one or more degrees of mealiness, were withdrawn in quantity required to provide 6 servings—approximately 750 gm. unpared (1, 3)—for measurement of their reducing sugar content and for french frying.

The picric acid coloration method was used for sugar determination (5). Samples were obtained by removing a cylindrical plug from each pared potato before it was cut into strips for frying. For each potato, the color produced by the test was matched as closely as possible to the colors reported for potatoes stored at 32, 36, 40, 50, or 60°F. (0, 2, 4, 10, and 15.5°C.), and the potato was classified accordingly into one of three groups as to its proximate content of reducing sugars. Potatoes producing coloration closest to that for potatoes stored at 32, 36, or 40°F. were classed as "excessive" in sugar; those producing coloration lighter than that for potatoes stored at 40°F. but darker than that for those stored at 50°F. were classed "moderate;" and those matching the 50°F. storage sample but darker than the 60°F.

TABLE 1.—*Yield of raw pared mealy, slightly-to-medium mealy, and non-mealy Katahdin potatoes, and of French fries, after potatoes were conditioned for different lengths of time at 70-75°F. (21-24°C.)*

Conditioning Period after Removal from Potato House	Mealy			Slightly-to-medium-mealy			Non-mealy		
	Potatoes per Lot Cooked[1]	Yield Raw Pared to Unpared	Yield French Fries to Raw Pared	Potatoes per Lot Cooked[1]	Yield Raw Pared to Unpared	Yield French Fries to Raw Pared	Potatoes per Lot Cooked[1]	Yield Raw Pared to Unpared	Yield Fries to Raw Pared
Days	Number	Per cent	Per cent	Number	Per cent	Per cent	Number	Per cent	Per cent
1	8	90.7	39.0	4	92.9	38.7	7	91.7	35.1
7	—	—	—	5	91.3	36.9	—	—	—
19	9	90.4	39.2	5	91.9	37.7	8	88.0	34.9
28	6	90.5	39.1	4	91.0	38.1	5	89.6	35.9
28	—	—	—	5	89.9	39.7	—	—	—
35	8	87.5	38.3	8	89.3	37.8	9	85.6	36.1
43	12	84.8	37.0	8	87.0	37.2	11	82.1	36.4
51	9	86.8	37.8	5	87.9	36.0	6	87.6	36.3
56	11	85.7	37.2	7	86.8	36.1	13	80.4	37.0
63	12	83.0	37.7	8	85.3	36.5	19	80.8	34.6
72[2]	17	80.2	39.9	8	82.8	38.8	6	84.1	36.2
84	—	—	—	8	84.3	38.2	8	80.7	37.6
91	—	—	—	—	—	—	9	78.0	38.3
Average	10	86.6	38.4	7	88.4	37.6	9	84.4	36.2

[1]Approximate weight, unpared, 750 gm.
[2]Non-mealy potatoes conditioned for 71 days.

were classed "slight" in sugar content. For each cooking sample, the percentage of tubers in each reducing sugar class was calculated.

The french fries were prepared by the standardized method (1, 3) developed in our laboratories, with the following modifications for mealy and slightly-to-medium mealy potatoes conditioned for 1, 19, and 28 days: The parfrying temperature was lowered from 195 to 190°C. (383 to 374°F.) and the final temperature from 210 to 202°C. (410 to 396°F.).

The quality of the french fries was judged subjectively for color, texture, flavor, degree of oiliness, and general acceptability (1). The color of representative fried strips was also matched to Maerz and Paul color charts (4).

Results and Discussion

In the Katahdin potatoes used in this study the salt-density test showed that slightly-to-medium mealy tubers predominated, and of the remainder there were more of the non-mealy than mealy tubers.

Per cooking sample the number of potatoes varied according to their size as is shown in table 1. As shown in the table, with longer conditioning and more small potatoes per sample, the yield of raw pared to unpared weight (including sprouts) decreased. The yield of french fries was apparently influenced by the degree of mealiness (table 1)—generally, the mealier the potato the greater was the yield of french fries.

One day after removal from potato house a majority of mealy and all slightly-to-medium mealy and non-mealy potatoes contained an "excessive" accumulation of reducing sugars as will be noted in table 2. As conditioning progressed to 72, 84, and 91 days for mealy, slightly-to-medium mealy and non-mealy potatoes, respectively, the excess of reducing sugars was decreased, but not entirely eliminated.

The rate of desugaring appeared to be influenced by the degree of mealiness of the potatoes as you will note in table 2. For example, the period of conditioning at which potatoes were not found in the "excessive" sugar class was 19, 35, and 51 days, respectively, for mealy, slightly-to-medium mealy, and non-mealy potatoes; non-mealy potatoes were found again in the "excessive" class at 56, 63, and 84 days. Similarly, the influence of degree of mealiness was shown by the period of conditioning at which a majority of potatoes was in the "slight" sugar class: 43 days for mealy; 63 days for slightly-to-medium mealy; and 91 days for non-mealy potatoes.

It should be noted that in any given period of conditioning, individual tubers in a cooking sample differed from each other in concentration of reducing sugars. Non-mealy potatoes were the most variable in this respect. For all three degrees of mealiness, differences among individual tubers may explain apparent inconsistencies in this trend toward lowering of the content of reducing sugars as conditioning progressed.

Color, or intensity of browning, of the french fries (table 2), appeared to be influenced mainly by the concentration of reducing sugars in the raw potatoes, a result in agreement with previous findings of the Bureau (8). In general, as the content of reducing sugars decreased during conditioning, the color of the french fries became correspondingly lighter, those made from the mealy potatoes progressing faster than those from the less mealy.

It is possible that factors other than reducing sugars affected the color of the fried potatoes, which may account for some of the results described—for example, certain slightly-to-medium mealy potatoes conditioned for 19 and 28 days, and non-mealy potatoes conditioned for 28, 56, and 84 days, although "excessive" in sugar content did not produce dark french fries.

Texture of french fries was significantly improved by progressive conditioning of the potatoes, with the degree of success depending on degree of mealiness. However, as shown by the descriptive terms in table 2, the french fries within a single cooking lot were frequently not homogeneous in texture. After conditioning for only one day, regardless of degree of mealiness, the potatoes produced, in the main, limp and soggy french fries. Conditioned for 43 to 72 days, mealy potatos produced crisp and mealy french fries; *i. e.,* of highly desirable texture. French fries made from slightly-to-medium mealy potatoes showed similar improvement in texture, but longer conditioning was required, 56, and 63 days, respectively; this quality was not maintained at 72 and 84 days, respectively. Non-mealy potatoes, although given the longest conditioning (91 days) did not produce french fries with texture equal to the best obtained from the mealier potatoes. Slight improvement in texture of french fries made from non-mealy potatoes was noted by some of the judges and described as a tendency toward crisping and flaking, reaching its peak at 71 days.

Degree of oiliness was associated with certain characteristics of texture, as, for example, limp and soggy french fries were usually considered by the judges excessively oily, whereas crisp and mealy

french fries were moderately to slightly oily. It is of interest to note with other varieties, where total fat content of the french fries was determined, that limp and soggy french fries contained more fat than crisp and mealy ones (3).

Flavors described as sweet and burned were noted by the judges here as well as in previous tests (8) of french fries made from potatoes with excessive accumulation of reducing sugars; bitterness was also noted in the present study. As progressive conditioning lowered the sugar content, the sweet and burned flavors disappeared, but bitterness persisted in many lots. There were, however, fewer reports of bitterness among french fries made from the mealy potatoes than from the less mealy.

General acceptability of french fries, using degree of mealiness of raw potatoes and periods of conditioning as criteria, was given highest ratings as follows: Mealy at 63 and 72 days—very good to excellent; slightly-to-medium mealy at 56 and 63 days—good to very good; non-mealy at 71 and 84 days—fair to good.

These studies have produced results of practical value since they showed that mealy and slightly-to-medium mealy Katahdin potatoes which contained excessive amounts of reducing sugars could be successfully utilized for french frying provided they were adequately conditioned. To accomplish this, from 56 to 72 days conditioning at 70 to 75°F. (21 to 24°C.) was required. It is worth noting that when the conditioning was inadequate the lowering of standard frying temperatures did not solve the problem of making good french fries from the oversweet mealy and slightly-to-medium mealy potatoes used in these studies. As an application of these findings, since the mealier potatoes "recovered" better than the non-mealy ones, it appears desirable to select mealy Katahdin potatoes in preference to non-mealy ones for storage at low temperatures and later use in the making of french fries.

Summary and Conclusions

Katahdin potatoes grown in Maine in 1945 and placed in storage in a potato house in Maryland during October of that year were withdrawn at intervals during February and March, 1946, sorted out into 3 lots according to degree of mealiness by a salt-density method, conditioned at 70 to 75° F. (21 to 24°C.) for periods varying from 1 to 91 days, tested for content of reducing sugars by the picric acid coloration method, and french fried. The yield and edible quality of the french fries were determined.

After conditioning for 1 day, potatoes were excessively high in reducing sugars and produced poor french fries. As the period of conditioning was increased, the content of reducing sugars decreased gradually but was not restored to normal. The mealier the potatoes, the more rapidly they desugared, and the higher the yield and the better the edible quality of the french fries. With adequate conditioning, mealy potatoes produced french fries which were rated very good to excellent, and slightly-to-medium mealy, good to very good. Non-mealy potatoes "recovered" less successfully and produced only fair to good french fries.

Results suggested that as a conservation measure for Katahdin potatoes which are to be stored at low temperature for later use in french frying, it appears desirable to store mealy rather than non-mealy tubers.

Literature Cited

1. Alexander, L. M., Schopmeyer, G. E., and Anderson, R. B. A standardized method for french frying potatoes. (In Press).
2. Denny, F. E., and Thornton, N. C. 1942. The third year's results on storage of potato tubers in relation to sugar content and color of potato chips. Contrib. Boyce Thompson Inst. 12, (6): 405-429, illus.
3. Hewston, E. M., Dawson, E. H., Alexander, L. M., and Orent-Keiles, E. 1948. Vitamin and mineral content of certain foods as affected by home preparation. U. S. Dept. Agr. Misc. Pub. 628, 76 pp., illus.
4. Maerz, A., and Paul, M. 1930. A Dictionary of Color. New York: McGraw-Hill Book Co., Inc. 207 pp., illus.
5. Peacock, W. M., and Brunstetter, B. C. 1931. A simple chemical test for predetermining the culinary quality of potatoes as affected by the accumulation of soluble sugars. U. S. Dept. Agr. Circ. 158, 4 pp., illus.
6. Smith, O. 1945. Potato mealiness determined by specific gravity. Farm Res. [N. Y. State Sta.] 11, (4): 13-14.
7. Wright, R. C. 1932. Some physiological studies of potatoes in storage. Jour. Agr. Res. 45, 543-555.
8. ———, Peacock, W. M., Whiteman, T. M. and Whiteman, E. F. 1936. The cooking quality, palatability, and carbohydrate composition of potatoes as influenced by storage temperature. U. S. Dept. Agr. Tech. Bull. 507, 20 pp.

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SECTIONAL NOTES

Michigan

The movement of potatoes out of Michigan this fall is far below that of last year for the same period of time. It would appear that our

volume is slightly under that of last year; but with the reduced movement to date, it would mean that from now on, the balance of the season, Michigan will have to ship more cars and trucks than were shipped out after December 1st last year.

Certified Seed bin inspection is now completed. The volume is slightly above that of last year. There is a noticeable shift in varieties, mostly from Russet Rurals to Katahdins.

A new record of high yields was established this year. Michigan has a 500-bushel club which is based on five or more checks on five or more consecutives acres. High yield, which is an all-time state record, was made by Paul Damme of Cornell with a yield of 1034 bushels per acre. This was not just an accident, as yields of more than 800 bushels per acre have been previously recorded on Paul's farm.

There is a rather interesting story of this Vam Damme family. Jules the father, came to Delta County, Michiga nfrom Belgium after World War I, and the Van Damme farm was cleared after the lumber company had removed the timber. The family was raised on this farm; and as it was cleared up and the boys grew up, more land was acquired and more land cleared. Today the Van Dammes are operating four separate units consisting of several hundred acres each. The Michigan 500 bushel-club is fairly well represented by the Van Dammes—Paul, 1034 bushels per acre; Jules (the father), 705 bushels; Gerald, 654; and two other brothers operating as Van Damme Brothers, 643 bushels per acre.—H. A. Reiley.

Nebraska

Bin inspection of all Nebraska Certified seed potatoes was completed by the 15th of November. Our records indicate that the yields and quality of dry land certified seed are better than last year. Yields under irrigation were somewhat lower, but the quality was much better, because of less scab and less mechanical injury. In 1948, 7,497 acres were accepted for certification; and in 1949, 6,280 acres. This reduction may be accounted for by the reduced acreage entered in 1949. Rejections and withdrawals were approximately the same both years.

Despite the reduced acreage, the supply of U. S. No. 1 Bliss Triumph seed is 418,220 cwt. in 1949, or only slightly under 432,179 produced in 1948. Other states producing Bliss Triumph certified seed also have good crops. Consequently, the competition for seed sales in the southern states continues. It appears that a lot of certified seed will be sold as table stock again this year.

The November shipments of certified seed from Nebraska are considerably lighter than in 1948. The volume of table stock shipments is also lower. Market prices are not satisfactory, and the demand is lighter than usual. Western Nebraska shippers have been packing and washing part time only. The growers are dissatisfied with present market prices. A few are selling part of their crop, but most of them are keeping them in storage, hoping for a better price after the first of the year.

Last year very few of our growers took advantage of Government support, because they were able to market their potatoes at prices above support. Most of them are eligible for support again this year, and will probably take advantage of Government support prices if the market fails to improve after the 1st of January.—W. A. TRANK

NEW JERSEY

Potato growers in many areas as well as in New Jersey experienced the poorest growing season on record. As a result tuber quality was somewhat affected by the poor growing conditions. Yields, in general, and the Cobbler variety, in particular, were much lower than average. Many tubers sprouted in the ground long before the plants were mature which resulted in increased labor costs when they were graded. Many potatoes that were harvested during the latter part of September or later were affected with a rot very closely resembling leak, although the Pythium organism, causing leak was not isolated from any of the diseased specimens examined. Potatoes that were placed in storage sprouted prematurely or broke down with soft rot in many instances. Because of these factors very few potatoes are now in storage in this state, probably less than in many years. Our growers are hoping for a more normal season next year.

Our seed growers experienced a little better growing season and a total of 30,900 bushels of seed was certified. Sixty-two per cent of the production was of the Katahdin variety; 22 per cent Chippewa; 5 per cent Red Skin; 4 per cent Sequoia, and the balance of the production was comprised of Pawnee, Cobbler and Mohawk.

NEW YORK

There were 4,200 acres of potatoes which passed inspection this year. This is 11 per cent higher than the amount certified last year. The Katahdin variety accounted for more than one-half the total acreage.

The yields per acre have turned out fairly well; far better than

expected earlier in the season. Our growers are complaining of unevenly-sized tubers, the majority of the complaints being against oversized tubers which developed during the humid period in September.

All samples from certified fields have been sent to Florida and planted there for winter testing.—F. JOHN MACABEE

SOUTH DAKOTA

Dry weather and insects reduced the potato crop in South Dakota far below normal. Certified growers harvested good yields in most cases, because of the use of good seed and a well planned spraying program. A total of 5229 acres of potatoes was entered for certification in 1949. Three hundred and thirty six acres were rejected at the time of the first inspection and 266 acres were withdrawn. Then 995 acres were rejected on the second inspection and 776 acres were withdrawn, before the second inspection. Our records show a production of approximately 350,000 bushels of stock eligible for certification. Most of these are in storage and will be graded after the 1st of January.

We have the same Marketing Agreement order in effect this season as we had last year, except that U. S. No. 1 "B's" may be sold. Shipments of potatoes grading below 80 per cent No. 1 quality are restricted. The C. C. C. buys the No. 2 grade and to date about 35,000 bushels have been purchased, or nearly 17 per cent of the shipment. Most of these have gone for livestock feed within the State, but lately the school lunch program and charitable institutions have used a few cars—JOHN NOONAN.

VERMONT

The yields of commercial potato fields in Vermont were heavy and the quality of stoc kput into storage was good. Little late blight injury was reported. The weather was good throughout the harvesting period and the crop went into storage in excellent condition.

Indicative of the high yields of the season were official computations made by County Agents for the "400 Bushel Club". Since membership in the "400 Bushel Club" is confined to certified seed growers, its possible membership is rather limited. Of the 12 who bothered to have check-ups made and were found to qualify, 9 would have made a "600-Bushel Club" and 2 would have passed a "700-Bushel" requirement Those men who ranked high were: Fred W. Peaslee of Guildhall, first, with 760.3 Bus/A Green Mountains; Rudolph Danforth, Tunbridge, second, with 701.5 Bus/A Green Mountains; Joseph Brow, Albany, third, with 689.4 Bus/A Katahdins; and C. J. Batten, E. Hardwick,

fourth, 644 Bus/A Katahdins.

The State's total acreage of certified seed was 573.

Except for one grower who has made some substantial sales in New Jersey, there has been little activity in the seed market.

Pecks are being put up at some of the warehouses, but many potatoes are being offered to the government on the support buying program.

Of the estimated total harvest of Vermont potatoes — 1,184,000 bushels — a good guess is that nearly a million are still in storage. A major part of these are in very small lots, many of which may be consumed in the homes where they were grown.—HAROLD L. BAILEY

DOMINION OF CANADA

With exhibits from every Province in Canada, except Newfoundland, and several from Minnesota and Michigan in the United States, the 1949 Potato Show at the Royal Winter Fair, Toronto, Ontario, Canada, was an outstanding success. It attracted a total of 368 excellent exhibits, each consisting either of 30 selected tubers, or one bushel lots. All were displayed on specially designed trays, arranged on slightly tilted tables so that each tuber could be readily seen, and the mass attracted wide-spread attention. First and second prize winners in various seed classes were:

White, Oval (Irish Cobbler etc.)
1. Gabriel Kolometz, Dunning, Ontario
2. G. MacMillan, Cornwall, P.E.I.

White, Oval, Intermediate (Chippewa, "etc.")
1. Theodore Despatie, Hanmer, Ontario
2. D. C. Hackett, Cochrane, Ontario

White, Oval, Late (Katahdin etc.)
1. Arthur H. Budarick Palmer Rapids, Ontario
2. John Henderson, Renfrew, Ontario

White, Oval, Extra Late (Sebago etc.)
1. Milton Weatherilt & Sons, Bethany, Ontario
2. Frank McManus, Grand Falls, N. B.

White, Intermediate Long (Green Mountain etc.)
1. Frank Rick, Trout Creek, Ontario
2. Theodale Michaud, St. Paul de la Croix, Quebec

Netted or Russet (Netted Gem etc.)
1. Ross Bros., Pemberton, B. C.
2. J. Decker, Pemberton, B. C.

Rose or Red (Warba etc.)

1. Arthur H. Budarick, Parmer Rapids Ontario
2. J. Pawson, Estevan Sask.

Any Other Variety

1. Gerald Trueman, Amherst, N. S. on Pawnee
2. Vic. Guichon, Ladner, B. C. on White Rose.

The World's Championship award made available by the American Potash Institute Inc., Hamilton, Ontario, was won by Theodore Despatie, Hanmer, Ontario, Sudbury District on his entry of Foundation A Chippewa.

Reserve Championship went to Ross Bros., Pemberton, B. C., on their entry of Netted Gem.

The Gray-Snyder Special for Chmpionship in the table stock classes was awarded to Arthur H. Budarick, Palmer Rapids, Ontario, for Katahdin, with Frank Rick, Trout Creek, Ontario, won reserve.

The Championship award for Ontario based on yield, marketable potatoes per acre, exhibit and cooking test was won this year by Frank Rick, Trout Creek, Ontario, in Parry Sound District with a yield of 836 bushels per acre. The prize is a Handsome Trophy, plus $250.00 in cash, and a trip to Toronto.

Prize winners from the U. S. A. were W. F. Haenke, Gilbert Minn., W. J. Mason, and August Newhaven, Virginia, Minn.; Elis Raati,, Gilbert, Minn.; and Thos. and Arvo Saari, Embarrass, Minn.

The judges were Prof. E. V. Hardenburg, Cornell University Ithaca, N. Y.; B. Baribeau, Ste. Anne de la Pocatiere, Que.; J. E. Birdsall, Edmonton, Alberta; and R. E. Goodin, Toronto, Ontario. — R. E. Goodin

Errata

Fungicide-Insecticide Combinations in Michigan for 1948," by J. H.

In the August 1949 issue, in the article entitled "Field Tests of Muncie and W. F. Morofsky, Table 2 should be labelled Table 2. Table 1 of this article was omitted entirely and is inserted in this issue.

In the August issue in the first article, the names of the authors should be reversed, since L. L. Dean is the major author.

Page 283 — Last line should read "applied in dust gave control."

Page 285 — Third line from bottom "aphthalene acetic acid" should read "Alphanaphthalene acetic acid."

Page 286 — The fourth paragraph, line four should read "whether applied in talc" instead of "where applied in talc."

Page 286 — In the fifth paragraph the first sentence should read, "Drying dipped tubers at 135°F. significantly reduced the effect of napthalene acetic acid and its sodium salt at the three and nine-gram per bushel rates at application as compared with, etc."